(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 453 163 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **91303152.2**

(22) Date of filing : **10.04.91**

(51) Int. Cl.⁵ : **A47L 9/00**

US 5134751633

(30) Priority : **18.04.90 JP 100324/90**

(43) Date of publication of application : **23.10.91 Bulletin 91/43**

(84) Designated Contracting States : **DE GB**

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(54) Vacuum cleaner.

(57) A vacuum cleaner has an electric blower (7) inside a generally cylindrical rigid blower casing (16,17) positioned inside the vacuum cleaner body (1). The blower casing has a lining of sound absorbing material (18) and is configured to cause a swirling flow around inside said casing to an exit opening (72) into a smoothly-curved transfer passage (73) which curves away from the blower casing with a non-radial flow direction. Transfer passage (73) curves circumferentially and also axially and opens into an annular noise reduction space (19) at the bottom of the cleaner body in which air is guided over a sound absorbing layer (20) by smoothly arcuate guide ribs (61), vented through an aperture (24) into an exhaust space (30) between the bottom of the body and a castor base (4) and escapes through a peripheral clearance (76) around the castor base.

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This invention relates to vacuum cleaners, and to means for reducing the noise they make.

Generally in a vacuum cleaner the air on the blower side of the filter passes through the blower fan and radially outwardly through e.g. window openings in the housing which forms part of the blower motor. Apart from noise made by the blower motor itself, a substantial contribution to noise is made by the passage of exhaust air from the blower motor housing to the one or more openings through which it escapes from the vacuum cleaner body. In the prior art it has been appreciated that the noise of this exhaust air can be reduced by causing it to pass along a passage, or through a space, containing a sound absorbing material such as a polyurethane foam.

Japanese Utility Model Laid-Open Publication 4872753 shows the blower mounted axially horizontally in a generally horizontal body, with a cylindrical tube encasing the motor housing so that the air escapes axially forwardly through an annular exit gap between this housing and the tube. The tube is lined with foam. The escaping air collects in a cylindrical annular chamber between the casing and the vacuum cleaner outer body, also lined with foam, passes rearwardly down a foam-lined passage through a right-angled bend to an expansion space at the vacuum cleaner rear end, and thence through low density foam and a grille to the exterior. Despite the sound absorbing material, the conformation of the exhaust part is such that the flow is repeatedly sharply bent and noise is generated.

Japanese Utility Model Laid-Open Publication 4884163 describes an axially upright-type cleaner with the blower centrally vertically mounted in a generally cylindrical space defined by the main body casing. To create a long exhaust path-way, a sheet of sound absorbing foam material is wound in this space in a spiral form extending out from the blower to the casing. However, the main air flow velocity is concentrated along the outside of its path, so the absorbing material along the inside is effectively wasted. Recently vacuum cleaner blower motors have become more powerful, which will exacerbate the problems associated with this construction.

JP-A-61/179121 leads the exhaust directly from the blower through a foam layer and into a flattened chamber at the base of the casing. The chamber has U-shaped guide channels for guiding the air over a sound absorbing layer before passage into a rear expansion chamber and through a grille to the exterior.

In the present invention, we address the problem of providing a new construction for the escape of exhaust air. In particular, in one aspect we address the problems which exist in the prior art regarding the exhaust air flow shortly after exiting the blower motor housing.

In this first aspect the invention provides a vacuum cleaner in which an electric blower is surrounded within the vacuum cleaner body by a hard blower casing which has a radially outwardly directed exit opening through which the exhaust air escapes from the casing to flow along a transfer passage in a curved path with a substantially non-radial directional component.

Desirably the interior of the casing is such as to establish a swirling flow of the exhaust air. Also it is highly preferable that the blower casing has a lining layer of a sound absorbing material e.g. a foam material. The disposition of sound absorbing material in the casing space may be used to establish the swirling flow.

Preferably the transfer passage curves away from the exit opening with a circumferential direction or component, and where there is swirling flow in the blower casing the sense of this should be aligned with the transfer passage direction.

Another possible directional component for the curved transfer passage is the axial direction (relative to the blower); particularly preferably this is combined with a circumferential component. Desirably the air flow direction at the exit opening is curved through at least 45° in the circumferential sense and/or the axial sense. In the very restricted space normally available inside a vacuum cleaner body, this may direct the flow to a useful location with a useful flow direction e.g. for passage into further noise reduction means. It is particularly preferable that the transfer passage extends without any sharp angle to disrupt the flow. Desirably therefore it forms a smooth continuous curve. Normally it will not be necessary for it to curve through more than 100° from the initial flow direction at the exit opening, indeed transfer passage deviation of less than 90° will frequently be sufficient to bring the flow to a useful location.

In a second aspect reflecting this special curving of the transfer flow, the invention provides a vacuum cleaner having a main body and an electric blower mounted within the main body, with an exhaust air pathway leading from the blower to the exterior of the main body in which the exhaust flow pathway comprises a casing space around the blower, with means for establishing an exhaust air flow in the casing space swirling circumferentially around the blower, and a transfer portion leading from the casing space with a gradually curving flow direction having a circumferential component following the sense of said circumferential swirl, and also an axial component relative to the blower e.g. to give a helical path.

The outer wall formed by the blower casing - which may have a generally cylindrical form around the blower axis - may advantageously merge with an outer wall portion of the transfer passage in a substantially continuous curve. The transfer passage desirably contains a sound absorbing element, e.g. of foam material. This may be disposed as a wall lining in the

passage e.g. as a lining along the outer wall portion of the passage curve.

In a particularly preferred aspect, the transfer passage opens into a noise reduction space before leaving the vacuum cleaner body. Desirably this space also contains sound absorbing material e.g. foam. To achieve sound absorption over a large extent of space, without sharp corners in the flow, it is commonly desirable that the noise reduction space occupy a substantial area in one plane. For example, the noise reduction space may be a chamber of a generally flattened shape in which the exhaust air is guided by at least one curved guide means in the space, and preferably a plurality of curved guide means defining channelled flow paths, e.g. over a layer of sound absorbing material.

Because of space restrictions in vacuum cleaner design, commonly such a flattened chamber needs to extend transversely to the radial extent of the blower casing e.g. across the bottom part of a vacuum cleaner body in which the blower casing is arranged axially horizontally. The special transfer passage features described above may enable exhaust air to be introduced into such a space without any sharp corners after exiting the blower casing.

Such a noise reduction space provided at the bottom of the vacuum cleaner body may vent downwardly into a space defined between the bottom of the body and a runner base on which are mounted means e.g. castors whereby the vacuum cleaner may be easily moved across a floor. The runner base and cleaner body may be relatively rotatable. The exhaust air flow may escape from this exhaust space through a peripheral gap defined around the body between the runner base and body. This disperses the flow direction in many directions and helps to eliminate noise.

In a further general aspect reflecting the above features, the invention provides a vacuum cleaner in which an electric blower is surrounded by a blower casing within the vacuum cleaner body, with a space between blower and casing for the passage of exhaust air from the blower, an exit opening in the blower casing opening into a transfer passage which leads in turn into a noise reduction space located adjacent the bottom of the vacuum cleaner body, having at least one arcuate guide and venting downwardly into an exhaust space below the body.

The blower casing of the vacuum cleaner may usefully be formed in two separable parts, and these may usefully define respectively opposing portions of the transfer passage. The preferred blower casing is a substantially rigid shell e.g. of plastics material which may be lined e.g. with sound absorbing foam. The blower housing may be surrounded by an air permeable foam layer through which the exhaust air must pass, within the casing, to help reduce motor noise.

Embodiments of the invention are now described by way of example, with reference to the accompanying drawings in which:

Figure 1 is a median vertical section of a vacuum cleaner, passing through a blower axis;

Figure 2 is a vertical section transverse to that in Figure 1, through the rear part of the vacuum cleaner shown in Figure 1;

Figure 3 is a horizontal section, viewed from above, through the blower and dust collecting casing of the vacuum cleaner;

Figure 4 is a front view of the blower casing;

Figure 5 is a bottom view of the vacuum cleaner body, and

Figure 6 is a vertical section at A-A in Figure 5.

Referring initially to Figures 1, 2 and 3, a vacuum cleaner of the "pot" type has a generally cylindrical axially upright body 1 consisting of a generally cylindrical upper body portion 2, closed at its upper end and incorporating a carrying handle 70, and a lower body portion 3 closing off the bottom end of the upper portion 2. At its front side, the upper portion 2 has an openable front cover 6 allowing access to a dust collecting chamber 9 incorporating a dust collecting filter 5. The dust collecting chamber 9 includes a generally cylindrical dust collecting casing 31 with a sealing inner cover 32 disposed inside the outer front cover 6 and having a hose socket 41 which receives, via a gas-tight packing 42, the end of a standard vacuum cleaner hose 62. Hose 62 is rotatably mounted, in a generally conventional way, in the socket 41 which is positioned inside the front cover 6. Inner cover 32 sealingly closes the front of a filter casing 58 containing a paper bag filter 5 which may be conventional.

Behind the casing of the filter 5, the dust collecting chamber 9 opens rearwardly into an enclosed blower space 8 through a microfilter 33 which is for retaining any fine dust which might interfere with speed control 40 of the electric blower 7. The blower 7 and its casing will be described in more detail below.

Above the blower compartment, in the top portion of the body 1, is an accessory compartment 13 accommodating a cord reel 11 for taking up in a conventional way an electric power supply cord 10 for supplying power to the blower. The compartment 13 also houses a control unit 54.

In the left-hand side of the body, to the side of the dust collecting casing 31, is a metal casing 60 accommodating electric parts such as a noise filter and a rectifier circuit, on a power source substrate. To the right-hand side of the dust collecting chamber 31 is accommodated a metal casing 57 (Figs. 2,3) in which large capacitors, for power-factor improving and smoothing, are packaged. An inverter circuit module 51 is attached to the bottom of the dust casing 31.

The vacuum cleaner is provided with a castor base 4, on which peripheral castors 27 are swivellably mounted. This is generally circular with an upturned periphery having a bumper 28 for preventing furniture damage, and receives the bottom part 3 of the

vacuum cleaner body 1. The lower body portion 3 is connected to the castor base 4 at a central axis by a rotation shaft 23 allowing the body 1 to be rotated without rotating the castor base 4. The lower body portion 3 also has a plurality - 3 or 4 - of running wheels 29 which roll on the inside of the castor base 4 so that the body 1 and base 4 rotate with a spacing 30 maintained between them. This spacing forms a chamber of generally flattened shape with an upturned edge portion which opens through an annular slot or gap 76 at the upper periphery of the castor base, defined on its inner side by the outwardly-facing surface of the lower body portion 3. This space 30 serves for exhaust discharge, as will be explained in detail below.

The blower arrangement is now described in more detail, with reference also to Figure 4. The blower 7 includes a blower fan 12 situated in the opening from the dust collecting chamber 9 and driven by an invertor-driven brushless electric motor 39. The motor and blower are mounted axially horizontally in the blower compartment 8 which is within the cleaner body 1 at the rear thereof. The blower compartment 8 is defined by an electric blower casing of generally cylindrical form, with a front casing portion 17 (on the side of the fan 12) and a rear casing portion 16 which is separable from the front portion 17 to facilitate installation of the blower 7. Front casing portion 17 has a central intake hole protected by plastic ribs 71. The cylindrical side wall 15 of the casing is formed integrally, as part of the rear portion 16, with a spherically-curved central portion 14 of the rear wall of the casing, which gives the casing shell good rigidity and strength and in use reduces blower noises in the lower frequency range, i.e. of frequency below 1000 Hz. The cylindrical housing 45 of the blower motor 39 is positioned coaxially within the cylindrical wall of the casing 16, 17, with a substantial radial spacing between housing and casing wall. The housing 45 of the blower includes openings so that exhaust air is blown radially outwardly from the blower, in a manner which may be conventional. In the embodiment shown, these openings are provided with forwardly-opening tail pipes 38 so that the air is blown out forwardly along two 90° segments on opposite sides of the blower, as can be seen from Figure 2. The tail pipes 38 may take other forms e.g. having a radially outwardly directed blower opening. Or, the tail pipes may be dispensed with altogether if desired.

Around the blower 7 outwardly adjacent the tail pipes 38, is a cylindrical air-permeable and flame-retardant cover 77 of e.g. low-density polyurethane foam, through which the exhaust air must pass. The cylindrical cover 77 helps to reduce the risk of fire and also reduces motor noise while smoothing the exhaust air flow.

As can be seen in Figure 2, the outer wall 15 of the blower casing is generally cylindrical at its upper portion. It has a lining, of substantially uniform thickness, of a sound absorbing foam element 18. A radial annular space 8 is defined between the sound absorbing member 18 and the inner foam cover 77, in which exhaust air can circulate within the blower casing. At its lower left-hand portion (as seen in Figure 2) the outer casing wall curves in more sharply to form a reduced radius portion in which the exhaust air circulation space 8 is substantially blocked off by the sound absorbing lining 18. At its lower right-hand portion, the outer wall 15 has an increase in curvature radius so that it extends away from the blower 7 and forms an outer wall of an exhaust or transfer passage 73 leading away from a substantially rectangular-section exit opening 72 penetrating the casing wall 15 at the lower right-hand portion thereof. The left-hand edge of the exit opening 72 is defined by a sharp edge between the blower casing wall 15 and an inner wall 51 of the transfer passage 73.

Transfer passage 73 has a generally rectangular cross-section. It is defined by a radially outer wall portion 100 which, as described, extends to merge as a continuous curve with the cylindrical wall 15 of the blower casing and is formed integrally therewith from the casing parts 16, 17. The radially inner wall 67 of the passage 73 extends generally parallel to the outer wall 100, and the internal cross-sectional area of the passage 73 is substantially constant. A rear wall portion of the passage 73 is formed adjacent the exit opening 72 by the rear casing portion 16 and, further downstream, by front casing portion 17. It extends initially in a generally circumferential direction, but curves gradually forwardly (i.e. axially) with a large radius of curvature until it is extending substantially axially forwardly relative to the blower. The transfer passage exit is substantially in axial register with the front ribs 71 of the casing 17. The front wall portion of the passage 73 is short and extends generally parallel to the rear wall portion, so that as explained the cross-sectional area of the passage 73 is not decreased.

All of the walls of the passage 73 are formed generally as smooth curves, with relatively large radius of curvature. The resulting passage 73 defines a flow direction which, from the radially-outward exit opening 72, extends initially in a substantially circumferential sense relative to the cylindrical casing 15 and then also curving forwardly in an axial sense so that the flow direction at the end of the passage 73, is substantially in a forward axial direction and the end of the passage 73 is disposed below and to the right-hand side (looking rearwardly) of the blower casing cylindrical portion. The flow direction in the passage 73 is generally guided in a smooth curve having a relatively large radius of curvature, without sharp corners. It diverts the flow direction through about 80° from its initial generally circumferential direction on exiting the casing. The walls of the passage 73 are formed as integral extensions of parts of the front and rear blower

casing portions 17, 16. Generally, the radius of curvature of the flow direction should not be less than about 5 cm at any point in the passage 73.

The outer (lower) wall portion 100 of the passage 73 is lined with sound absorbing material, e.g. polyurethane foam 18 which occupies between 25% and 50% of the passageway cross-section, and extends as a continuation of the sound absorbing lining 18 around the outer wall 15 of the blower casing.

At the exit opening 72, the outer wall portion 100 comprises a projection 21 which extends through the sound absorbing material to form a hard constriction or throat at the entrance of the passage 73. In manufacture, the size of the projection 21 and hence the area of the throat is selected in dependence on the power of the electric blower. The throat does not divert the exhaust air flow axial direction through a corner, but provides a hard boundary constriction in a manner which is effective to provide some noise reduction.

The blower casing and walls of the passage 73 are formed of hard plastics material and are mounted in the vacuum cleaner body through damping rubber annuli 68, 69 at the rear and front, to reduce vibration transmission from the blower to the body 1. Furthermore, the blower is itself mounted inside the blower casing through front and rear rubber damping members 36, 37 to inhibit further the transmission of vibrations.

The end of the exhaust transfer passage 73 opens substantially horizontally into a noise reduction chamber 19 which is formed generally in a ring shape in the bottom of the lower body portion 3, around the pivot housing for the castor base mounting. The noise reduction chamber 19 has a generally flat horizontal top wall 22 of rigid plastics and defines a substantially C-shaped expansion space extending for about 200° in a generally flattened shape in the bottom of the body portion 3. The top wall 22 of the space 19 is in vertical register with the top wall of the exhaust transfer passage 73 as the latter passage leads into it, and the passage 73 is of substantially the same vertical depth as the chamber 19. Furthermore, the chamber 19 has a layer 20 of sound absorbing foam, like that in the blower casing and of substantially the same thickness, forming a lower surface thereof. The sound absorbing member is supported on radial floor spokes 102 (Fig. 5) a little distance above the body portion 3, so as to allow some circulation of air below it. Extending down from the top wall 22 are a plurality (two, in this embodiment) of arcuate guide ribs 61. These extend vertically down from the top wall 22 to the sound absorbing lower layer 20 and are curved in a circular arc around the C-shaped chamber space 19 from the opening of the transfer passage 73 through about 200° to a downwardly opening exit aperture 24 through the bottom of the lower body portion 3. Consequently the space 19 contains three part-annular channels, each having as a top wall the top wall 22, as a bottom wall the sound absorbing layer 20, and as side walls either two of the ribs 61, or a rib 61 and a wall of the body portion 3. Each of these concentric channels leads from the transfer passage around the bottom of the vacuum cleaner body to the opening 24 in the bottom of the body. As can be seen in Figure 6, at the exhaust aperture 24 through the body the upper wall of the space 22 curves down smoothly in a guide portion 74 having a large radius of curvature. The downwardly directed aperture 24 is covered with a metal wire mesh 75 (not shown in Fig. 5) which serves to smooth turbulences in the exhaust flow on passing through the aperture 24 into the exhaust space 30 defined between the bottom of the body portion 3 and the upper surface of the castor base 4.

In operation, the air flows in the vacuum cleaner are as now described. Reference should also be made to the arrows in the drawings. In the usual way, air flow sucked in through the hose by the operation of the blower 7 passes through the dust collecting chamber 9, is filtered by the filter bag 5 and further by the micro-filter 33. It then passes into the electric blower 7 and out through the tail pipes 38 of the blower. The tail pipes guide the flow either forwardly or outwardly, according to the design, over the two 90° segments of the blower circumference as seen in Figure 2. The air then passes out through the sound-absorbing cover 77 and into the space 8 between the blower cover 77 and the sound-absorbing lining 18 of the blower casing. With reference to Figure 2 it is seen that the exhaust air must escape radially outwardly from the casing through exit opening 72, while to the left of exit opening 72 the lower casing space 8 is partially obstructed by the inturned sound absorbing member 18. Accordingly, a swirling flow is established in the clockwise direction as seen in Figure 2, whereby the exhaust air must circulate around the blower casing space 8 towards the exit opening during which course noise is absorbed by the sound-absorbing layer 18 in the casing. However, a certain proportion of air from one tail pipe can escape anti-clockwise into the exit opening, as seen in Figure 2. This is important if the electric blower has a high performance. If the exhaust flow swirling in the exhaust casing is too fast, the flow will concentrate excessively at the outside of the space 8 in the casing and noise absorption potential of the sound absorbing members 18, 77 will be reduced. However, the overall exhaust flow velocity in the casing can be reduced if a portion, e.g. 10 to 20%, of the exhaust flow is allowed to pass directly (anti-clockwise) into the exit opening as shown in Figure 2. Alternatively, if the blower is very powerful, the overall exhaust velocity can be reduced by enlarging the blower chamber. This is undesirable if, as is commonly the case, there is only restricted space inside the cleaner body 1, and it is not wished to enlarge the body. Accordingly, in manufacture, it is necessary to consider the perform-

ance of the intended blower 7 and to configure the inside of the blower casing and its lining so as to obtain if necessary a proportion of direct (non-swirled) or reverse flow into the transfer passage.

Passing into the transfer passage 73, the air flow goes through the throttle caused by the projection 21 and this serves to reduce some noise. Passing along the passage 73, noise is further reduced by passing over the sound absorbing lining 18 therein. Furthermore, since the flow does not run up against opposing surfaces in the passage or at the exit from the blower casing, generation of undesirable noise is avoided.

The double-curved configuration of the exhaust passage 73 brings the air flow conveniently down into the lower horizontal plane of the annular noise reduction space 19, into which the air flow can pass still without negotiating any sharp radius. In the space 19, the flow is guided around the C-shape channels, being prevented by the ribs 61 from concentrating at the outside of the annular space. Accordingly, good use is made of the sound absorbing layer 20 over the full extent of the space 19. Reaching the vent aperture 24, the air flow is guided down smoothly by the guide portion 74, smoothed by the wire net 75 and passes into the exhaust space 30 between body and castor base. At this point the flow does undergo a sharp change in direction, since it meets the castor base surface substantially perpendicularly. However, by this point the potentially noise-generating energy of the exhaust air has been largely dissipated by the passage through the blower casing space 8, the transfer passage 73 and the noise reducing space 19. Also, the vent aperture 24 is made large so that the vent velocity of the exhaust air is low and noise generation by collision with the castor base is not significant. The vented air is then dispersed around the wide and flat exhaust space 30 and can escape in all directions through the narrow slot opening 76 at the periphery of the castor base. Accordingly, not only is a large exhaust area provided by this aperture 76, but also the escape flow has no particular direction. This further reduces the impression of noise emanating from the vacuum cleaner. Because the final exit from the vacuum cleaner is not downward, the exhaust flow does not blow up dust form the floor.

It will be appreciated that, in the vacuum cleaner described above, a highly advantageous noise-reducing effect is achieved with good economy of space, by passing the exhaust flow from the blower casing in a non-radial flow direction - specifically a circumferential flow direction - along a gradually curved transfer passage and into a noise reduction space including a sound absorbing member and in which throughout the air flow is not subject to sudden turning of angles before it reaches the vent aperture 24.

Claims

1. A vacuum cleaner having a main body (2,3) and an electric blower (7) mounted within the body, characterised in that the blower (7) is in a hard blower casing (16,17) disposed in the main body (2,3) with a radial space between the blower (7) and the blower casing (16,17) for the passage of exhaust air to an exit opening (72), leading radially outwardly from the blower casing space (8) into a transfer passage (73) defining a curved exhaust flow direction which extends away from the lower casing (16,17) and curves away from the outward radial direction relative to the blower (7).

2. A vacuum cleaner according to claim 1 in which the flow direction defined by the transfer passage (73) extends initially with a substantial circumferential component away from the exit opening (72).

3. A vacuum cleaner according to claim 1 or claim 2 in which the flow direction defined by the transfer passage (73) curves axially away from the exit opening (72).

4. A vacuum cleaner according to any one of claims 1, 2 and 3 in which the blower casing (16,17) has a lining of sound absorbent material (18).

5. A vacuum cleaner according to any one of the preceding claims in which the transfer passage (73) has a lining of sound absorbent material (18).

6. A vacuum cleaner according to any one of the preceding claims in which the blower casing (16,17) and an outer wall (100) of the transfer passage (73) form a continuous curve past the exit opening (72).

7. A vacuum cleaner according to any one of the preceding claims in which the cross-sectional area of the transfer passage (73) is at least maintained in the flow direction.

8. A vacuum cleaner according to any one of the preceding claims in which walls of the transfer passage (73) are formed integrally with the blower casing (16,17).

9. A vacuum cleaner according to any one of the preceding claims in which the blower casing comprises a front part (17) and a rear part (16) which fit together to define the blower space (8).

10. A vacuum cleaner according to any one of the preceding claims in which the transfer passage

(73) opens into a noise reduction space (19) of the main body (2,3) containing at least one curved guide (61) for guiding exhaust flow in a curved path therein.

11. A vacuum cleaner according to claim 10 in which the noise reduction space (19) is annular.

12. A vacuum cleaner having a body (2,3) and an electric blower (7) mounted within the body, with a noise reduction space (19) in the body in which exhaust air from the blower (7) is guided in an arcuate path by at least one arcuate guide (61) before venting to the exterior of the body (2,3), characterised in that
a blower casing (16,17) is provided around the electric blower (7), with a space (8) inside the blower casing (16,17) for passage of exhaust air to a curved transfer passage (73) communicating between the blower casing space (8) and the noise reduction space (19);
and in that the noise reduction space (19) vents downwardly to below the body (2,3).

13. A vacuum cleaner according to any one of claims 10 to 12, comprising a runner base (4) spaced below the body (3), with a peripheral gap (76) extending around between the runner base (4) and body (3) to allow escape of air vented from the noise reduction space (19).

14. A vacuum cleaner according to any one of the preceding claims in which the transfer passage (73) has a regulating throat (21) at or adjacent the exit from the blower casing (16,17).

15. A vacuum cleaner having a main body (2,3) and an electric blower (7) mounted within the main body, with an exhaust air flow pathway leading from the blower (7) to the exterior of the main body (2,3),
characterised in that
the exhaust flow pathway comprises
a casing space (8) around the blower (7), with means for establishing an exhaust air flow in the casing space swirling circumferentially around the blower, and
a transfer portion (73) leading from the casing space (8) with a gradually curving flow direction having a circumferential component following the sense of said circumferential swirl, and also an axial component relative to the blower (7).

16. A vacuum cleaner according to claim 15 in which the exhaust flow pathway further comprises
a noise reduction space (19) following the transfer portion (73), in which the air flow is guided in an annular path portion over a noise absorbent surface (20), commencing with a substantial continuation of the flow direction at the exit from the transfer portion (73), by curved guides (61).

FIG.1

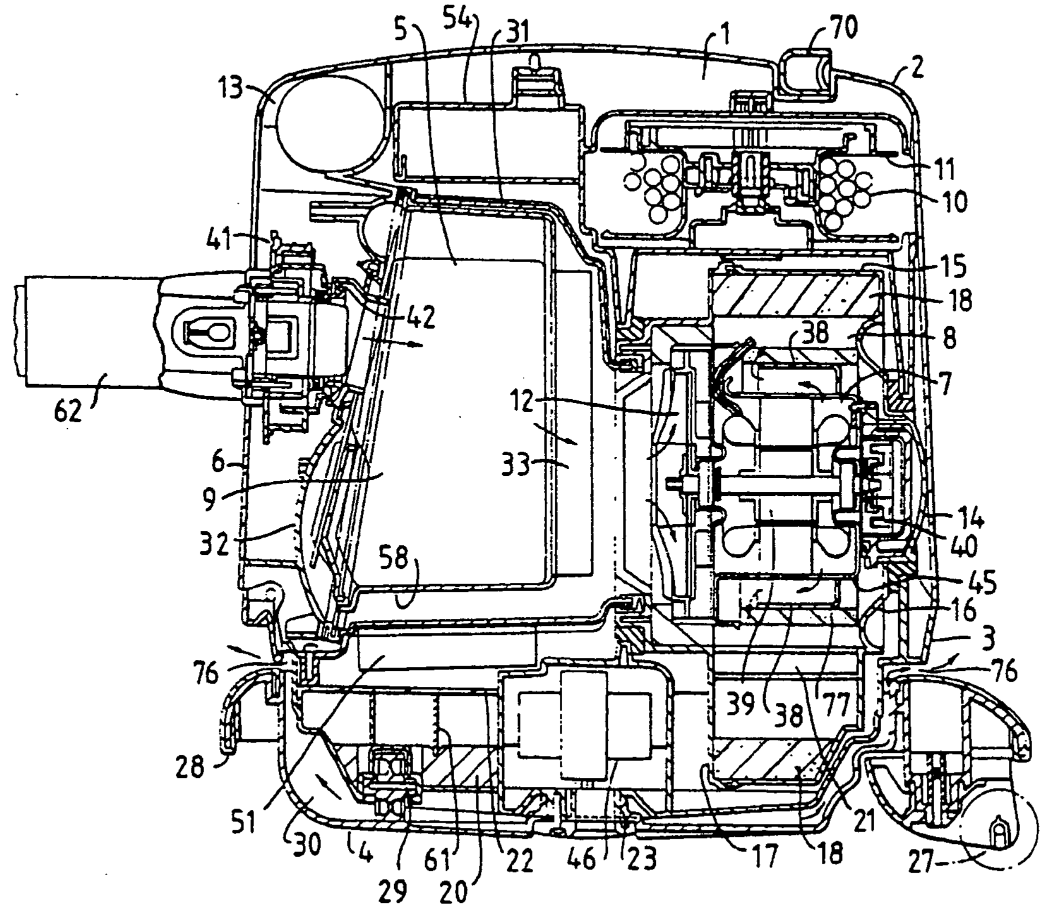
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FIG. 2

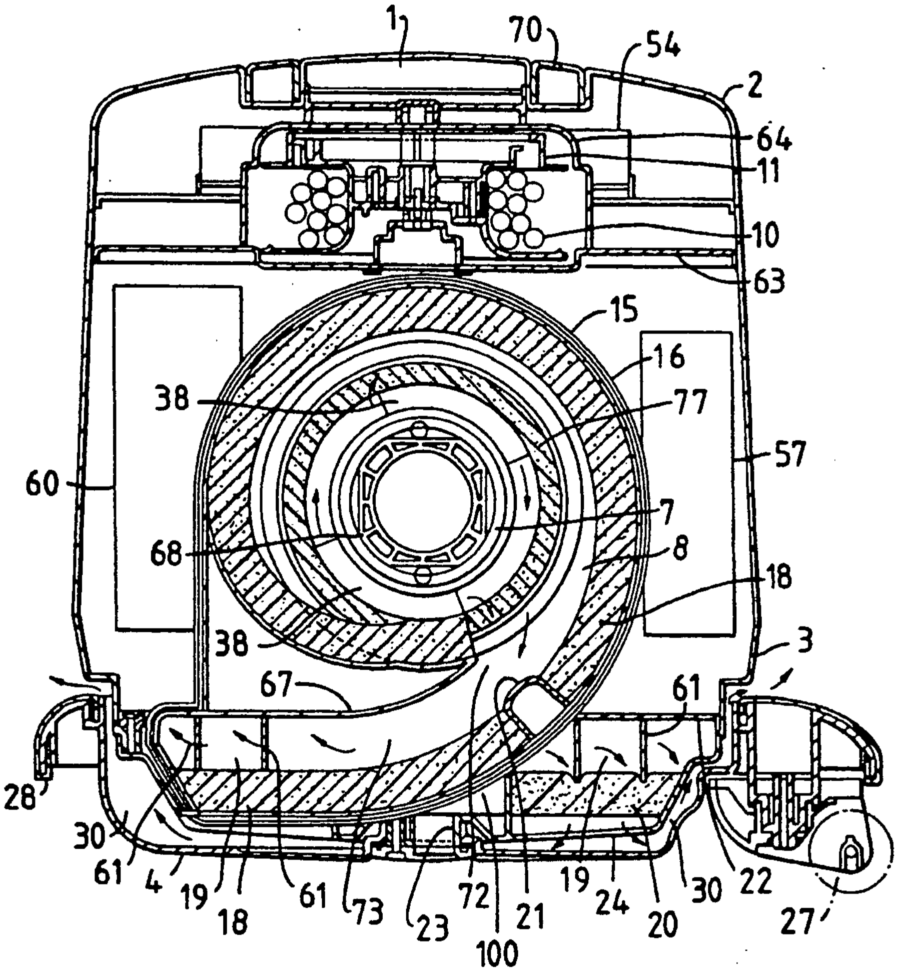
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FIG. 2

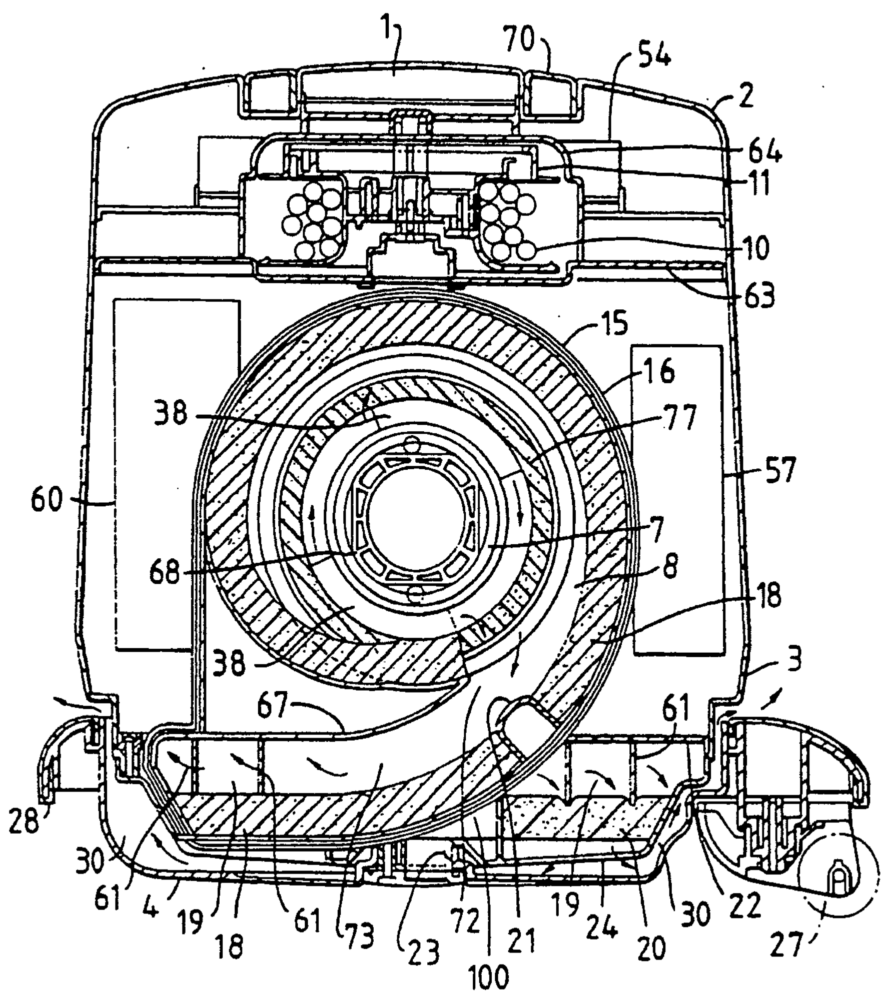
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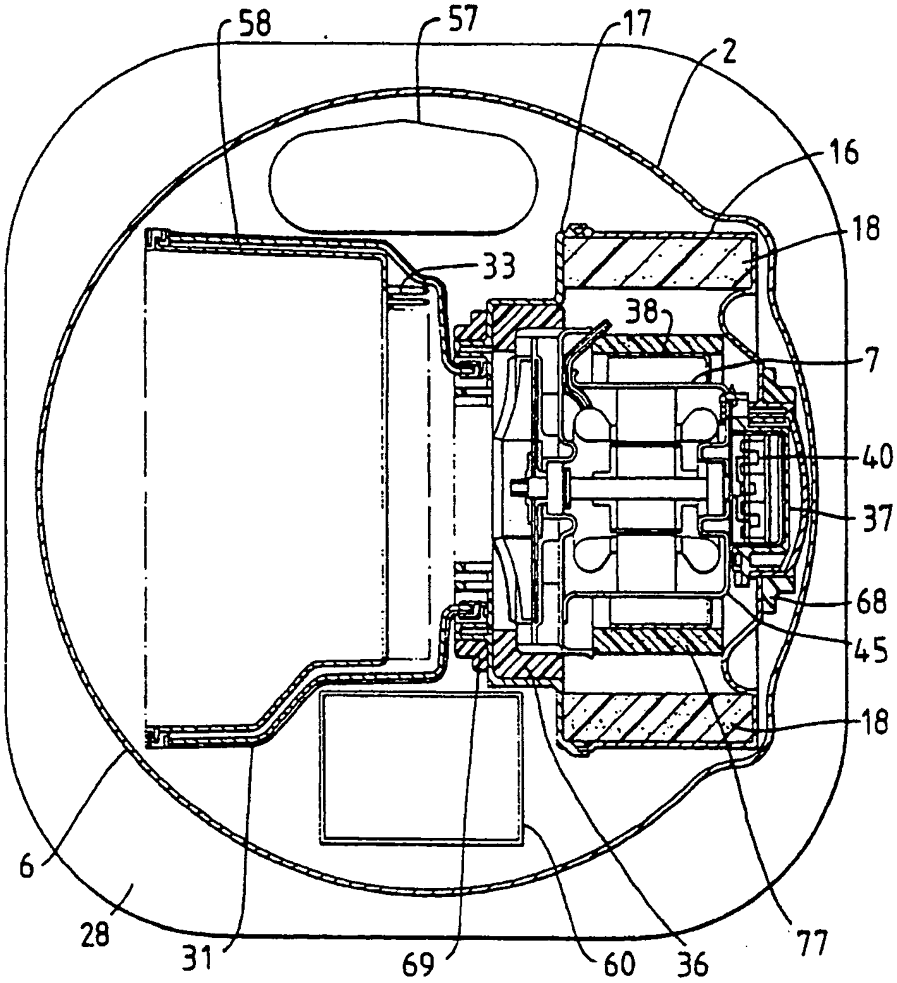
FIG.3



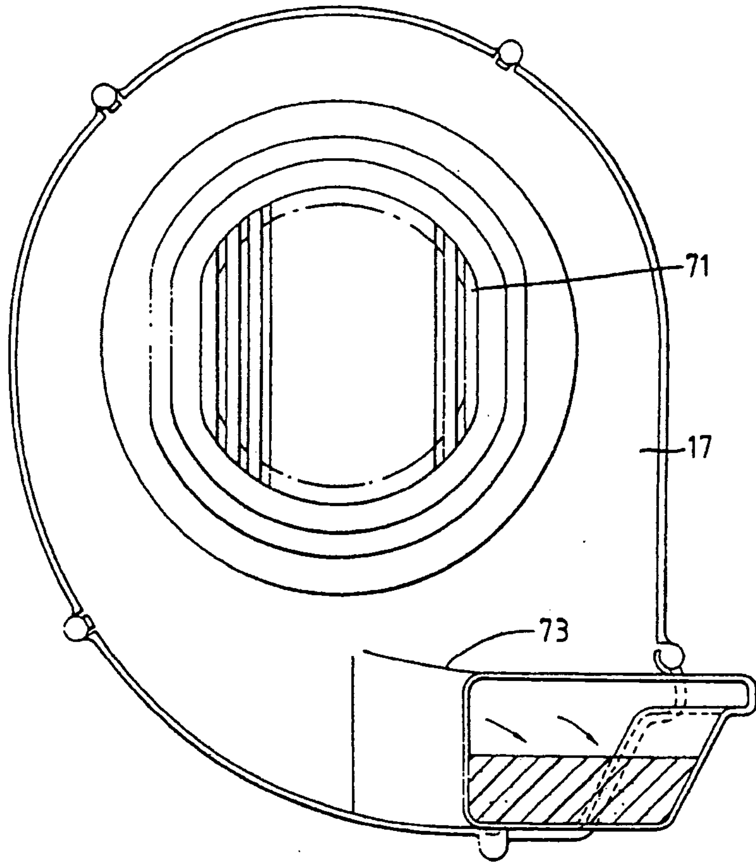


FIG.4

FIG.6

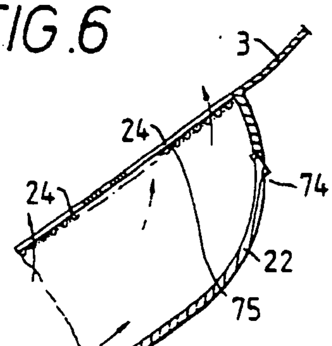
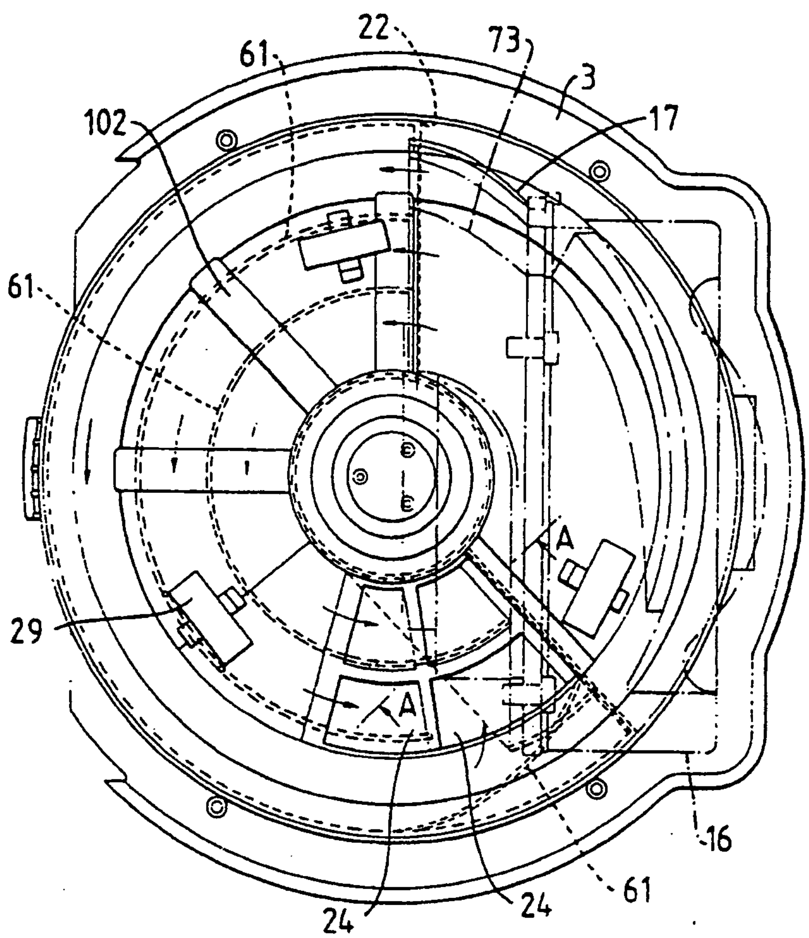


FIG.5



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EUROPEAN SEARCH REPORT

Application Number

EP 91 30 3152

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-362 895 (HITACHI LTD)	1-3, 11-13	A47L9/00
	* column 4, line 43 - column 12, line 41; figures *		
A		16	
X	EP-A-289 987 (HITACHI LTD)	1-8,12, 15	
	* the whole document *		
A		16	
X	EP-A-184 113 (PROGRESS-ELEKTROGREATE MAUZ & PFEIFFER) * the whole document *	1,4	
X	DE-A-3 815 320 (LICENTIA PATENT-VERWALTUNGS-GMBH) * the whole document *	1-3,8	
A		12,15,16	
P,X	EP-A-382 926 (PROGRESS ELEKTROGERAETE GMBH)	1,3,6-8, 12	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
	* the whole document *		A47L
A	GB-A-2 117 229 (SHARP KK) * figures 4-8 *	1	
A	US-A-3 503 558 (F.L. GALIULO & AL) * the whole document *	13	
A	DE-U-7 514 249 (SIEMENS AG) * abstract *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03 JULY 1991	M. VANMOL

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